Sediment Quality on the Continental Slope off San Diego, California: A Pilot Study of Deep Benthic Habitats

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Summary

Little is known about benthic conditions on the continental slope off southern California, although the region may be a major sink for the accumulation of contaminants. To begin investigating such habitats as part of enhanced ocean monitoring objectives for the San Diego region, the City of San Diego and the Scripps Institution of Oceanography implemented a Deep Benthic Pilot Study (DBPS) in October 2005. The DBPS was designed to target depositional areas west of the City's monitoring region for the Point Loma Ocean Outfall and an EPA designated disposal site (LA5). Although the DBPS focused on both biotic and abiotic conditions, this poster presents results for sediment quality only.

Sixteen sites were distributed along 4 offshore transects at depths of ~200, 300, 400 and 500m, and then modified to target areas considered most susceptible to sediment and contaminant accumulation. Stations were grouped into 3 site classes based on geography, sediment composition and slope. Sediment quality was assessed by collecting and analyzing one 0.1 m^2 grab sample per site for grain size, total organic carbon (TOC), total nitrogen (TN), total volatile solids (TVS), sulfides, trace metals, chlorinated pesticides (e.g., DDT), and PCBs. Bottom water conditions (e.g., temperature, dissolved oxygen, salinity, pH) were characterized for each site based on CTD data.

Results suggest little evidence of significant contaminant accumulation in the study area. No pesticides or PCBs were detected at any site. Sediment chemistries were closely linked to grain size composition. Sediments sampled from the axial valley of a submarine canyon near the outfall were coarser and had correspondingly lower concentrations of metals and organic enrichment indicators than those sampled in the alluvial plain of the canyon and nearby slope. Alluvial and deep sediments were organically enriched with lower oxygen concentrations in the overlying waters. These preliminary results are being compared to sediment data from shallower sites (<200m) on the San Diego mainland shelf and to other deep habitats sampled throughout the Southern California Bight during a broader, multi-agency regional monitoring project conducted in 2003 (Bight'03). Implications and recommendations for future monitoring of deep benthic habitats off San Diego will be addressed.
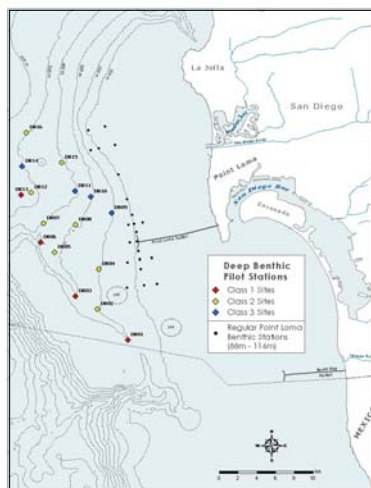
Site Selection & Distribution

Sites were originally placed along 4 depth contours (200, 300, 400, 500m) and nested into groups of similar microhabitats (e.g., sediment type, slope). Microhabitat assessments were made by comparing existing backscatter data from a high-resolution multibeam seafloor mapping survey conducted by the USGS in 1998 to known values for grain size distribution at the City's regular monitoring stations off Point Loma. The 16 DBPS sites were then classified into 3 groups (site classes) based on geographic location, sediment composition, and steepness of slope.

➤ **Class 1** (axial valley) includes 4 sites (1/depth) at the bottom of the axial valley/alluvial fan of the Loma Sea Valley where there was ~200-300m of 0-2% sloping area.

➤ **Class 2** (low slope) includes 8 sites (2/depth) distributed throughout a larger area and characterized by relatively soft sediments and a slope of <2%.

➤ **Class 3** (high slope) includes 4 sites (1/depth) located in steeper 2-5% sloping areas with soft sediments similar to Class 2.
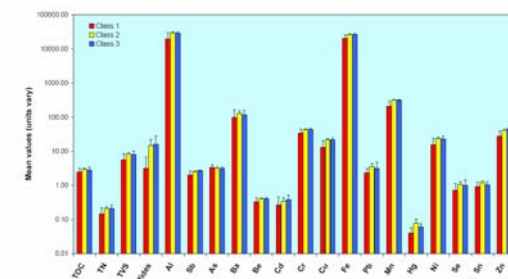
Contaminant Summary by Site Class

Average concentrations of TOC, TN and TVS (%wt), sulfides (ppm), and trace metals (ppm) in sediments by site class. Y-axis = log scale.

➤ Axial valley (Class 1) sediments were generally characterized by lower concentrations of organic indicators (TOC, TN. TVS, sulfides) and trace metals than found at Class 2 or Class 3 sites.
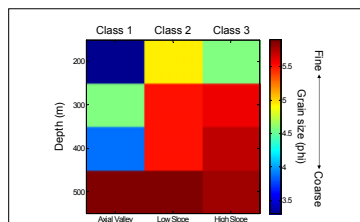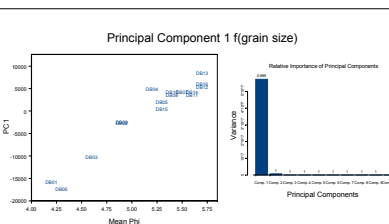

Grain Size Composition

Median phi plotted against depth and site classes, with low slope replicates averaged together.

➤ Axial valley (class 1) sediments from 200-400m were generally coarser (median phi = 3.3–4.6) than alluvial plain and slope areas.

➤ Finest sediments in all site classes occurred at deepest 500m sites (median phi = 5.8–5.9).


Contaminant & Grain Size Relationship

Contaminant concentrations in sediments were closely linked to grain size composition.

➤ Most metals (Al, Ba, Be, Cd, Cr, Cu, Fe, Ni, Sb, Zn) highly correlated with each other; Pb and Hg moderately correlated; Ag and As very poorly correlated with other metals.

➤ PCA results for metals, TOC, TN and sulfides (above) indicate that primary axis accounts for nearly 99% of the variance, and that metal and organic indicator concentrations are closely linked to grain size.
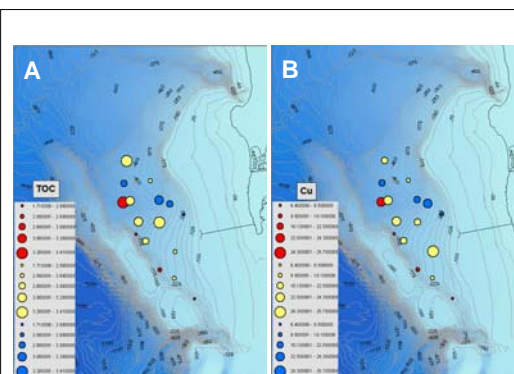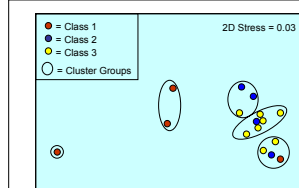

TOC & Copper Distributions

GIS plots illustrating typical distribution of organic indicators and metals at deep benthic study sites.

➤ Relative concentrations of TOC (A) and copper (B) at each DBPS site (Class 1 = red, Class 2 = yellow, Class 3 = blue).

➤ TOC and copper values were generally higher at alluvial plain and slope sites than the axial valley (Class 1) sites.

Ordination & Cluster Analyses

Results of MDS ordination and cluster analysis of TOC, TN, TVS, sulfides and metals (PRIMER)

➤ Data analyzed using Bray-Curtis similarity, square-root transformed, standardized.

➤ Class 1 (axial valley sites) = significantly different from either Class 2 or Class 3 sites (ANOSIM); Class 2 and Class 3 not significantly different.